A-CDM description and operational implementation challenges

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Abstract

The purpose of this research is to discuss a subject that, today, is a significant challenger of all the International Civil Aviation Organization (ICAO) signatory countries: the implementation of the Performance Improvement Areas preconized in the Global Air Navigation Plan (GANP).

To achieve the objective of providing a better understanding of Airport Collaborative Decision Making (A-CDM) processes the strategy chosen was to present the vision and implementation of the main entities representing the aviation area, such as the didactic form as the article is sequenced and the case studies discussed will present solutions for countries that aren't so advanced in the implementation of their A-CDM operational processes. Also, the article will act as a guide for all stakeholders. The contribution of the research will be to provide further support to all stakeholders in the air transport sector, regarding basic knowledge and more technical approaches of compliance with the recommended guidelines for the next decades in GANP. ICAO. In this specific case, regarding Performance Improvement Area: Airport Operations and the A-CDM module.

Keywords

Airport Operations; Global Air Navigation Plan (GANP); Airport Collaborative Decision Making (A-CDM); Performance Improvement Areas

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1. INTRODUCTION

Among the areas of performance improvement advocated by International Civil Aviation Organization (ICAO) in the Global Air Navigation Plan (GANP), to be implemented in the coming decades, and to integrate the projects of each signatory country, Airport Operations and Airport Collaborative Decision Making (A-CDM) appear as items of significant importance for Air Traffic Flow Management (ATFM). The A-CDM concept started more than a decade ago in Europe and its equivalent to Surface-CDM in the USA, established a new way to optimise operations at airports through a more efficient collaboration between all interested parts. This innovative approach, based on transparency and sharing of information, is now a well-documented, strongly supported concept, and accepted worldwide by concrete results at various airports.

A-CDM is a process that provides a positive response to the problem of congested airports. It is supported by the International Civil Aviation Organization (ICAO), Civil Air Navigation Services Organization (CANSO), International Airport Council (ACI), and International Air Transport Association (IATA). Today, manuals dealing with Future Air Navigation Systems (FANS) such as the Single European Sky Air Traffic Management Program (SESAR), the USA's Next Generation Air Transportation System (NextGen) and Japan's Collaborative Actions for Renovation of Air Traffic Systems (CARATS), already incorporate several variants of A-CDM. Each of these organisations and projects has developed a vision according to their specific needs and context. The A-CDM is a mindset, and working methods change to improve the airport operations performance and provide better overall predictability, allowing the stakeholders to work together as a team for mutual benefit. The process is based on transparency and information sharing among key stakeholders, starting with the establishment of collaborative work methods and practices [1].

In the current Air Traffic Management (ATM) concept, when the demand for traffic exceeds available capacity at airports or air traffic control units, aircraft are retained at the airport, these actions cause a lot of delays and ATFM slots troubles. A-CDM is a new process in the air traffic system using the concept of proactive decision-making, which aims to replace the current centralised system of air traffic management with collaborative decision making in respect to the airport's airside operations. To establish such a system, it is necessary to include, in the air transport system, all stakeholders and deliver timely information to all users. The main stakeholders in this system are the Air Traffic Controller (ATC), Airports and Airlines [2].

The A-CDM approach, which involves ATC and Airports, is one of the fundamentals contained in the GANP that will guide aviation in the coming years. This knowledge is of vital importance for those in the air sector, especially occupants of management positions in the air traffic services, airports and airlines operational areas so that they can interact operationally with the air traffic control agencies and airport operations areas. Thus, a set of performance improvements processes to achieve the objectives are suggested, such as in Airport Operations, this theoretical basis is essential, as well as the understanding of the importance, diversity and flexibility of its application [3].

This paper describes and highlights the main characteristics and points that include the operationalisation of an A-CDM, bringing the vision of the leading system implementers today, such Europe and the USA, air sector associations representatives, such as CANSO and IATA, and academics. Also, considers the contribution that the academy has given in the field of decision support, and collaborative decision using studies by [4], as well as the work of [5], which allowed us to measure the effectiveness of the operational and decision-making processes.

This paper has practical, scientific, methodological, social and personal relevance. In practice, the results of this study can clarify and mark actions to air sector members and serves as the primary theoretical basis for those who should start working with Aviation System Block Upgrades Methodology (ASBU) and A-CDM. Scientifically provides support for future academic research in the field.

2. LITERATURE REVIEW

2.1 Methodologies

Multiple Case Study was adopted for the preparation of this paper to facilitate the understanding, illustrating and giving more credibility, to the Case Study methodology, which will allow presenting some analysis and solutions already performed at the international level. According to [6], case studies can cover multiple cases and then draw a unique set of cross-case solutions. The same author considers that in some areas, multiple case studies have been considered a different "methodology" than single case studies.

However, to illustrate in this paper, it is interesting to highlight one of the most appropriate methodologies in studies and processes implementation, such as the one studied. The characteristics of the aviation sector and, more particularly, the airports and the air traffic control services, always recommends collaborative actions applications. Moreover, the Collaborative Decision-Making (CDM), now widely adopted by ICAO, is a recommended process to be applied by managers and stakeholders.

2.2 The GANP and ASBU Understanding

According to GANP 2016-2030 [7], the ASBU methodology is an approach that aims to facilitate and enable each state to move forward in their air navigation capabilities based on each of their specific operational needs. Such a block system will allow the sector to achieve global harmonisation, increase capacity and improve environmental efficiency - improvements that are requirements imposed by the air traffic growth in all regions of the world. Considering these needs, ICAO has developed a comprehensive system of block improvements, mainly to ensure that aviation safety is maintained, improved and ATM programs can be effectively harmonised and not put any barrier to future aviation efficiency. Moreover, environmental gains and a reasonable cost of implementation efficiency. The primary foundation of the concept is linked to four specific issues and interrelated areas of performance improvement (Figure 1):

a) Airport operations;
b) Interoperable systems and data at the global level;
c) Optimum capacity and flexible flights; and
d) Efficient flight paths.

The technologies and procedures for each Block were organised into Single Modules, based on their respective Performance Improvement Areas. In systems engineering developed by ICAO for its Member States, they only need to contemplate and adopt, the Modules suitable to their operational needs. Not all States will have an obligation to implement each Module. ICAO will be working with its Member States to support and guide, and to determine, precisely according to their operational requirements, which capacities they should have in each of their systems.

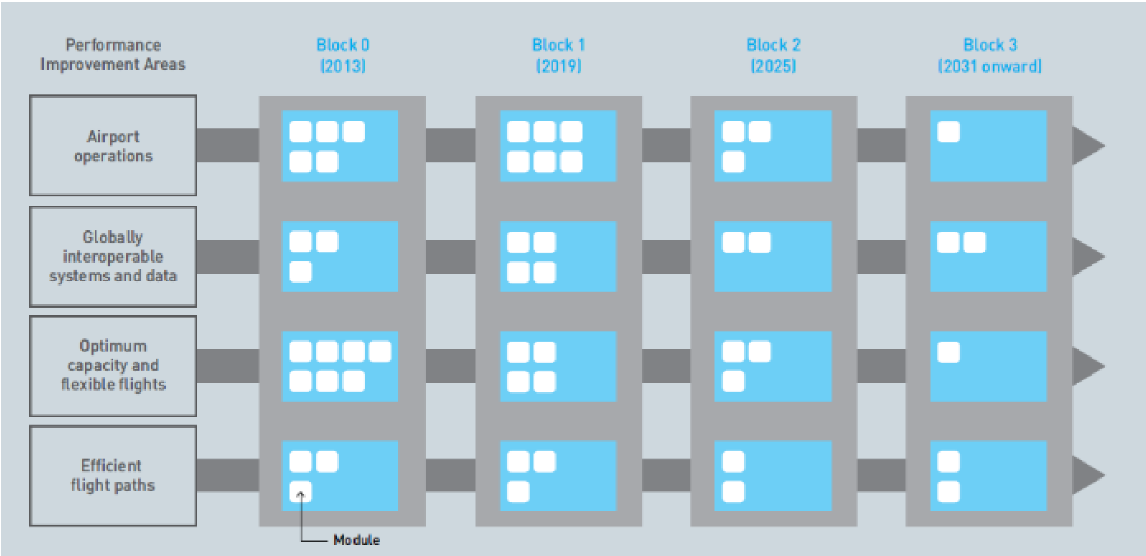

Figure 1: The ASBU standard.
Source: [7]

These four performance improvement areas showed in Figure 1, and the so-called ASBU modules associated with each one was organised into a series of four blocks (Block 0, 1, 2 and 3) based on timelines for the variable, which is contained, as illustrated in Figure 2 (Blocks 0 and 1).

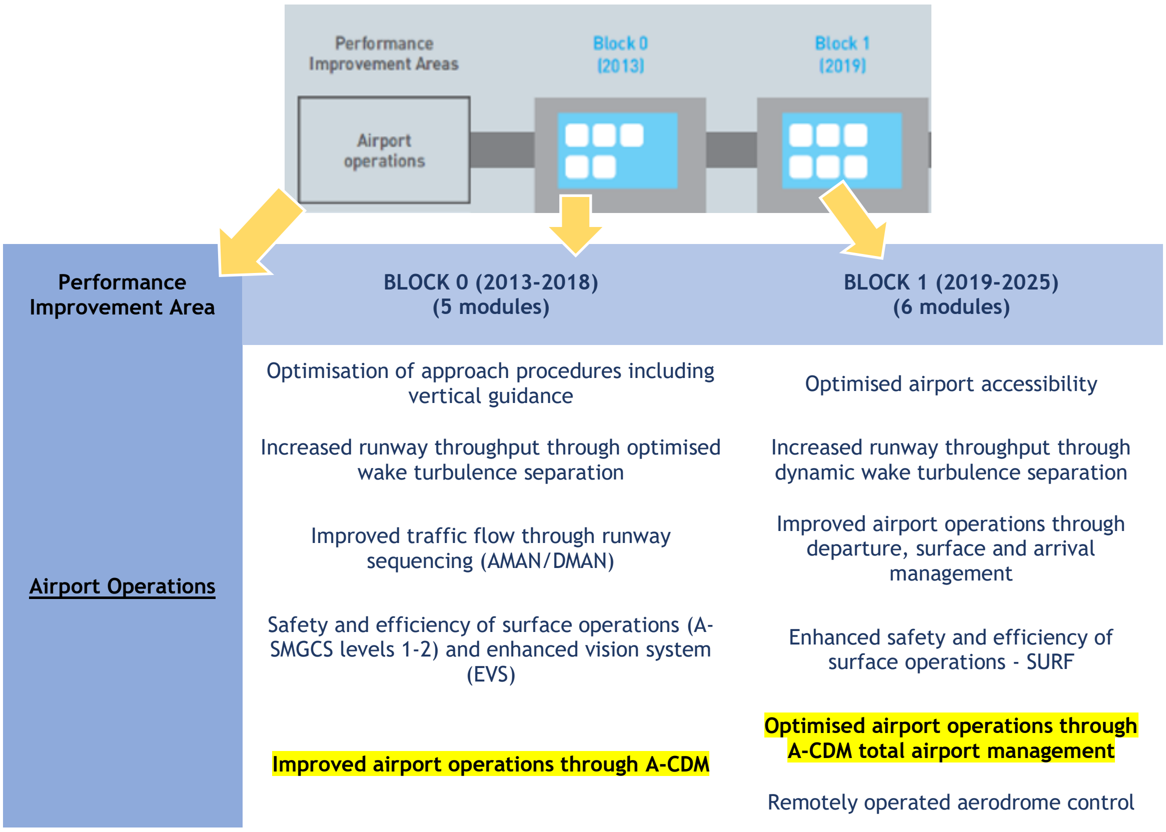

Figure 2: ASBU - BLOCK 0 and 1 – MODULES focused in A-CDM
Source: Own elaboration based on the ASBU standard [7]

ASBUs are not comprehensive, nor are they an umbrella system, but remain flexible modules that can be used by States according to their individual operational needs. One of the hallmarks of ASBUs is that they define technologies and procedures that are calculated to improve operational performance, mainly when the need came for an operational problem to be solved. The goal is to achieve global harmonisation and interoperability of air navigation [9].

2.3 Collaborative Decision-Making (CDM)

The A-CDM concept is based on a general idea about collaborative actions, called CDM. From this concept, the ICAO starts to apply it in aviation.

According to Steiner, Stimac and Melvan [2], the implementation of Airport-CDM involves a change in procedures and a cultural change in all the interested parties involved. The author's further state that the system is based on two main elements:

a) Predictability of events - which would result in the optimisation of each process related to aircraft and airport operations; and
b) On-time performance of operations - which would influence the increase in capacity of the airport and ATC on one side and, more directly, the efficiency of airlines and the use of aircraft on the other.

CDM at congested airports has demonstrated that considerable improvements could be gained at airports by air transportation agents, without sacrificing internal objectives and the means for different operators to achieve them. The goals of A-CDM are to reduce delays and improve system predictability while optimising the utilisation of resources and reducing environmental impact. An airport is ready to be considered a CDM airport only when A-CDM Information Sharing (ACIS), Turn-Around Process (CTRP) and Variable Taxi Time Calculation (VTTC) concept fundamentals are useful at the coordinated airport. In Europe, airport CDM has been implemented successfully at several airports and are expanding. Collaborative Air Traffic Management is now a key component in both SESAR and NextGen [10].

2.3.1 CDM – ICAO Overview

According to ICAO documentation DOC 9971 dealing with the subject [11], CDM defines a process focused on how to decide on a course of action articulated between two or more community members. Through this process, members of the ATM community share information related to that decision, interact, establish everyday choices and apply the approach and principles of decision making. The overall purpose of the process is to improve the performance of the ATM system while balancing the needs of individual members of the ATM community.

2.4 Airport Collaborative Decision Making (A-CDM)

Collaborative decision-making at airports is a process that provides a concrete response to the problem of congested airports. It has become essential in recent years, a process supported by the International Civil Aviation Organization, the International Airport Council, the International Air Transport Association and the Civil Air Navigation Organization.

2.4.1 A-CDM. The ICAO Normative Measures

Collaborative decision making at the airport is a set of philosophy processes of collaborative decision-making applying in aerodromes operations

The A-CDM allows airport and aircraft operators, air traffic controllers, ground handling agents, pilots, and traffic flow managers to exchange operational information and work together to manage aerodromes, A-CDM can also improve the planning and management of en-route operations. The A-CDM defines the rules and procedures used by aerodrome participants to share information and collaborate. The A-CDM enables all stakeholders to streamline their operations and decisions in a collaborative environment, considering their preferences, known constraints, and the predicted situation. The decision-making process is facilitated not only by the sharing of accurate and timely operational information through a standard set of tools but also by the application of agreed procedures and procedures. The primary objective of the A-CDM is, therefore, to generate a shared situational awareness that will foster better decision-making. The A-CDM, however, does not weak or eliminate the responsibilities associated with decisions. Decisions are still made, and A-CDM partners remain accountable for their actions. They are, however, taken collaboratively and, as a result, are better understood and applied [11].

2.4.2 A-CDM. The IATA Overview

According to IATA [12], A-CDM is designed to improve overall airport and network efficiency through improved turnaround processes, harmonising sequencing, surface and departure management. IATA supports common objectives and performance metrics between all A-CDM stakeholders, based on mutually agreed targets:

a) Airport Operations;
b) Aircraft Operators;
c) Ground Handling;
d) Air Traffic Services; and
e) Air Traffic Flow Management.

2.4.3 A-CDM. The EUROCONTROL / SESAR Overview

According to Eurocontrol [13], an airport is ready to be considered a CDM Airport when information sharing, milestone approach, variable taxi time, pre-departure sequencing, adverse conditions and collaborative management of flight updates elements are successfully implemented at the airport. The future European ATM system depends on the full integration of airports as nodes into the network.

This above Eurocontrol report, indicates enhanced airport operations, ensuring an all-in-one process through collaborative decision-making (CDM), in normal circumstances, and through the further development of collaborative recovery procedures in adverse conditions. In this context, this feature addresses the enhancement of runway throughput, integrated surface management, airport safety nets, and total airport management. It also introduces some initial concepts, above which, are basic definitions to guide the implementation of the operational concepts, which are meticulously explained in the 363 pages of the Airport CDM Implementation – Manual.

2.4.3.1 Eurocontrol MANUAL (basic definitions)

According to Eurocontrol [13], Airport Collaborative Decision Making is the concept which aims at improving Air Traffic Flow and Capacity Management (ATFCM) at airports by reducing delays, improving the predictability of events and enhancing the utilisation of resources. Implementation of Airport CDM allows each Airport CDM Partner to maximise their decisions in teamwork with other Airport CDM Partners, knowing their preferences and constraints, and the actual and predicted situation. The decision making by the Airport CDM Partners is facilitated by the sharing of accurate and suitable information and by adapted procedures, mechanisms, and tools. The Airport CDM concept is divided into the following elements:

a) Information Sharing;
b) Milestone Approach;
c) Variable Taxi Time;
d) Pre-departure Sequencing;
e) Adverse Conditions; and
f) Collaborative Management of Flight Updates.

2.4.4 A-CDM. The FAA / NextGen Overview

The traffic management CDM between flight operators and the FAA has been in existence since the mid-1990s. Recent surface traffic management projects have confirmed the potential efficiency and environmental benefits that can be realised from counting other aviation stakeholders, including airports, into the CDM process. The CDM activities in airports have become active, and they have found it valuable in managing aircraft movements, gate management, de-icing operations, ground service equipment coordination, special events, tarmac delays, and Irregular Operations (IROPS). ACDM is thought to be a means of coordination and a tool through technology that is only valid and achievable by the larger airports; though, it can be used by smaller airports as it assists all size airports with their situational awareness. Smaller airports can be significantly impacted during IROPS, and it is their ability to have information quicker that allows them to activate their plan sooner and presumably more effectively with the least amount of impact on the airport's operations or the affected passengers [14].

According to U.S. *Airport Surface Collaborative Decision Making (CDM) Concept of Operations (ConOps) in the Near-Term* [15]: the Surface Domain is a Core Element of the NextGen Implementation Plan (NGIP) AND, the Surface Collaborative Decision Making (CDM) concept will enable U.S. airports to make optimum use of available airport capacity. Thus, increasing traffic management efficiencies across the National Airspace System (NAS). The concept describes the need for timely sharing of relevant operational data among Surface CDM Stakeholders to improve situational awareness and predictability, through a shared understanding of "real" airport demand and predicted imbalances between the demand and public airport capacity. At the core of this concept is a set of well-defined capabilities and procedures, which facilitate the proactive management of surface traffic flows and runway departure queues, via the continuous assessment of airport capacity and demand. The skills and processes are expected to improve the efficiency of surface traffic flow at U.S. airports while reducing environmental impacts. It is understood that Surface CDM capabilities and corresponding procedures must be transparent, flexible, agile, and, equally important, capable of supporting the distinct needs of individual U.S. airports and the unique business models of different Flight Operators.

3. A-CDM OPERATIONAL IMPLEMENTATIONS AND CHARACTERISTICS

3.1 Framework

The planning and operation of an A-CDM should always consider a preliminary assessment of the current operational constraints and which critical implementation milestones, and corresponding milestone should be adjusted to mitigate such restrictions, thus improve the aerodrome and air traffic flow operating conditions.

An airport is considered as *CDM* airport when *A-CDM Information Sharing (ACIS)*, *Turn-Round Process (CTRP)*, and *Variable Taxi Time Calculation (VTTC)* concept elements are applied at the airport. CTRP describes the flight progress from the initial planning until take-off by defined '*milestones*' to allow close monitoring of significant events. Flight Update Messages (FUMs) and Departure Planning Information (DPI) are in place to inform all participating CDM partners about the flight progress. Monitoring the flight between the period of milestone that defines aircraft landed, and aircraft off-block milestone is a complex task because situational awareness has to be established across various subsystems of different organisational and operational structures having their causal and intentional domain constraints. ‘Subsystems’ here refer to actors who include airport operator, airline company, air traffic control, ground handler, and Central Flow Management Unit (CFMU). Additionally, all terminal and ramp processes have operational interdependencies, e.g. methods can typically not be parallelised, as well as legal requirements, e.g. one side of the aircraft must be clear of obstructions to ensure that firefighting access is always possible [16].

3.2 Stakeholders Recommendations

Corrigan et al. [17] state some consolidated overview recommendations that were accepted by the stakeholders at the airport in the A-CDM implementation:

a) Appoint a dedicated A-CDM coordinator in all stakeholder organisations (airport, ground handling, airline, ATC, fuel, cleaning, catering etc.) that can attend all project meetings;
b) Each coordinator develops a communication strategy for their respective organisations. Create a project team to develop an overall airport-wide communication strategy;
c) Create a sense of collective leadership across all actors to ensure a win-win attitude for all actors;
d) Clearly define and agree on objectives and key performance indicators at global and individual stakeholder organisations;
e) Prioritise the visiting of other stakeholders’ operational space regularly. Make this a fundamental tool for ensuring a common operational picture between stakeholders. This kind of action may be developed into a regular programme of cross-training;
f) Develop an agreed strategy for rewarding collaborative behaviour and discouraging non-collaborative practice;
g) Develop a dedicated training programme to deal with the softer issues of communication and collaboration; and
h) Address the issue of what communication support and methods are required to support the turnaround process operations.

3.3 The Eurocontrol Milestone Approach Concept Element

According to Eurocontrol [13], in the processes of A-CDM, it is common to use the term Milestone, widely used in Project Management. It originates from the stones used to mark the distances at the edge of a road or path. In the cases of A-CDM are used as determinant milestones of each activity (termination of some stage and changes of phase, transition or completion of steps within the process).The milestone approach element describes the progress of a flight from the initial planning to take off by defining Milestones to enable close monitoring of significant events. The aim is to achieve an everyday situational awareness and to predict the forthcoming events for each flight with off-blocks and take off as the most critical events.

A total of 16 basic Milestones have been defined. The list of Milestones is indicative; more milestones may need to be included to cover for extra information updates on critical events, such as de-icing. Local procedures may dictate that some milestones may not be required and are therefore considered as not highly recommended. For each milestone, there are Time References, previously defined or that vary according to each airport, which should be presented and systematically updated to all stakeholders (Table 1).

Table 1
Milestones Descriptions
Source: Own elaboration based on Airport CDM Implementation [13].
*Highly Recommended (HR) or Mandatory; and Recommended (R) or Optional Milestone.

N. °	MILESTONES	DESCRIPTION
1/HR	ATC Flight Plan activation	The ICAO flight plan is submitted to the ATC. At this time the flight is activated on the Airport CDM Platform, and all available information is processed. Usually, this occurs 3 hours before the EOBT. However, it may be later. In many cases, a repetitive flight plan (RFPL) is already in the database covering daily or weekly flights.
2/HR	Estimates Off-Block Time (EOBT): - 2 hs before	At EOBT -2 hr most flights will be known in the Airport CDM Platform including if they are regulated or not. If the flight is regulated, a Calculated Take Off Time (CTOT) is issued at EOBT –2h.
3/HR	Take Off from outstation	The Actual Take Off Time (ATOT) from the outstation (Departure Aerodrome - ADEP). The outstation provides ATOT to the Network Operations and Aircraft Operator.
4/HR	Local radar update	The flight enters the FIR (Flight Information Region) or the local airspace of the destination airport. This information usually is available from the Area Control Centre (ACC) or Approach Control Unit that is associated with an airport. The radar system can detect a flight based upon the assigned SSR code when the flight crosses a defined FIR/ATC boundary.
5/HR	Final approach	At the destination airport, the flight enters the Final Approach phase. This information usually is available from ATC. The radar system detects a flight based upon the assigned SSR code and identifies when the flight crosses either a defined range/position or passes/leaves a predetermined level.
6/HR	Landed	ALDT – Actual Landing Time. It is the time that an aircraft touches down on a runway. Provided by ATC system or by ACARS from equipped aircraft.
7/HR	In-block	AIBT - Actual In-Block Time. It is the time that an aircraft arrives in blocks.
8/R	Ground handling starts	Commence of Ground Handling Operations (ACGT). Specific to flights that are the first operation of the day or that have been long term parked. For flights that are on a normal turnaround, ACGT is considered to commence at AIBT.
9/R	Final confirmation of TOBT	The time at which the Aircraft Operator or Ground Handler provide their most accurate TOBT considering the operational situation. The information is provided *(t) minutes before EOBT. Where *(t) is a parameter time agreed locally).
10/HR	Target Start-Up Approval Time issue	The time ATC issues the Target Start-Up Approval Time. The information is provided (t) minutes before EOBT, where (t) is a parameter agreed locally.
11/R	Boarding starts	The gate is open for passengers to physically start boarding (independent of whether boarding takes place via an air-bridge/pier, aircraft steps or coaching to a stand).
12/R	Aircraft ready	The time when all doors are closed, boarding bridge removed, push back vehicle connected, ready to taxi immediately upon reception of TWR instructions.
13/R	Start-Up request	The time that the start-up is requested.
14/R	Start-Up approved	This is the time that an aircraft receives its Start-Up approval.
15/HR	Off-block	AOBT – Actual Off-Block Time. The time the aircraft pushes back/vacates the parking position (Equivalent to Airline/Handler ATD – Actual Time of Departure ACARS=OUT).
16/HR	Take off	ATOT – Actual Take Off Time. This is the time that an aircraft takes off from the runway.

3.4 The FAA Operational Approach

3.4.1 Implementing CDM at Airports

According to Guidebook for Advancing Collaborative Decision Making (CDM) at Airports (Vail et al., 2015), to perform ACDM either as a leader or partner, airports will be required to commit financial and staff resources to the effort. A-CDM is also a process that may require expanded communications and enhanced communications/outreach programs. Thus, it is desirable for the airport to assign specific staff to lead and track A-CDM activities. During the implementation of A-CDM, it is essential that airport staff understands management's goals and objectives and the airport's commitment to A-CDM. Not unlike most complex programs and efforts, such as the implementation of Safety Management Systems (SMSs), A-CDM is a change in the way airports do business and will require staff training to assure effectiveness. In other words, airport staff will need to be trained on A-CDM background and procedures before it can successfully be deployed. They recommend three necessary steps to start an A-CDM project:

a) Step One - Problem Identification;
b) Step Two - Developing the A-CDM Approach; and
c) Step Three - A-CDM Implementation.

3.4.2 The FAA Milestones

The U.S. Airport Surface Collaborative Decision Making (CDM) Concept of Operations (ConOps) in the Near-Term [15] considers three key milestones to be found in the operation of a Surface CDM (A-CDM) that need to be completed before a flight can depart.
These milestones are:

a) Flight Planning
   - Relative to the filing a flight plan, network-wide resource planning, it enables a Flight Operator to achieve maximum utilisation of its resources by adapting to changing conditions based on accurate, timely information. For example, Flight Operators may use airport aircraft surface surveillance data, integrated with airspace and National Airspace System (NAS) status data, to detect and understand the nature of any demand/capacity imbalances affecting airport surface traffic.
b) Pushback
   - Relative to the pushing back from a gate/parking stand, it is anticipated that the participating Stakeholders will share the following information: *Scheduled Off-Block Time (SOBT); Earliest Off-Block Time (EOBT); Updated flight intent information; Operating limitations affecting the departure of an aircraft; Actual Off-Block Time (AOBT); and Access to pushback and other specified event data.*
c) Taxiing on the Airport Surface
   - *Taxiing to a Holding Area* - A gate may be needed for an arrival, making it necessary to push back a departure earlier than otherwise would be required. In such cases, Ramp Control and ATC coordinate as essential to taxi the aircraft to the designated holding area. Using surface surveillance and flight intent information, Surface CDM monitors current and predicted the capacity of the holding areas.

A-CDM is as a process, not as a project, a process that when implemented brings unique operational advantages to air operators, airports and airspace control, consequently to the final customer, the passenger, who is the biggest beneficiary of the improvements implemented. Economic and environmental factors are also huge components favourable to deployment (Figure 3).

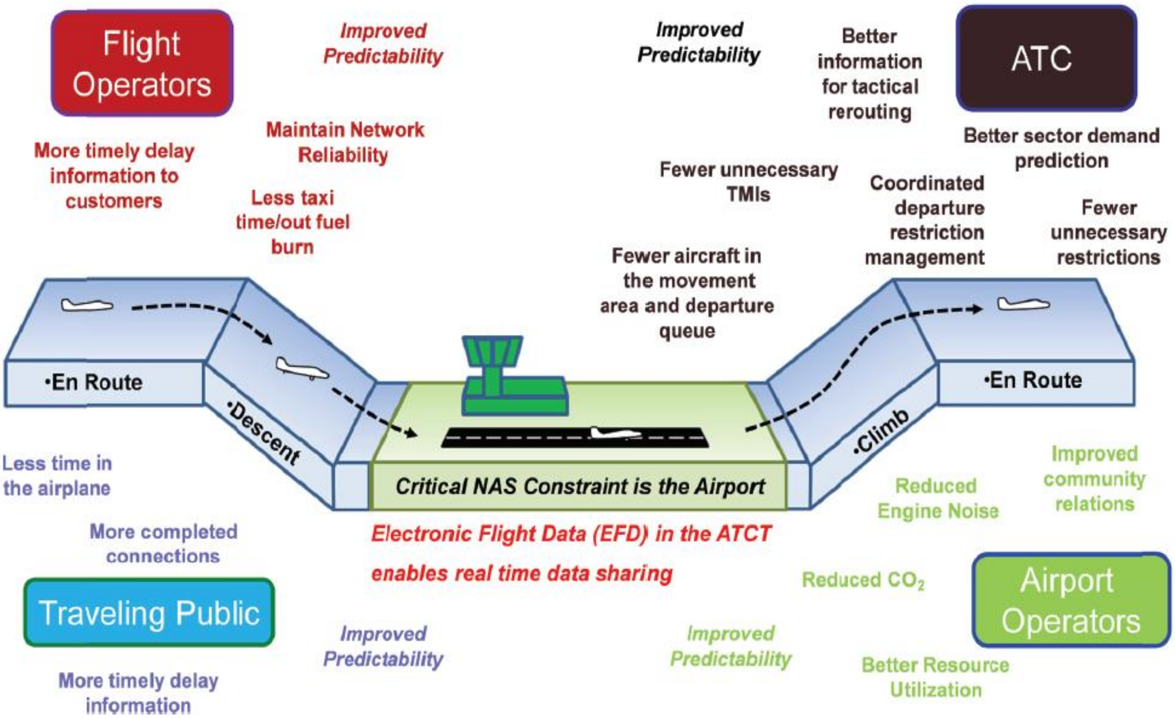

Figure 3: A-CDM efficiency benefits.
Source: Guidebook for Advancing Collaborative Decision Making (CDM) at Airports [14]

4. CONCLUSIONS

The complexity of a CDM deployment at large airports, receives several approaches from signatory countries and their ATM Systems, based on the recommendations of the ICAO Global Air Navigation Plan. In all these airports, especially those of greater importance, we have seen confluent points that, regardless of airport size, should always be part of A-CDM processes. The process will always involve three significant stakeholders: airport, air traffic control and air carriers, all connected around a regulatory entity and the application of the Operational Concepts (ConOps) they recommend, applicable for each state.

In the A-CDM creation, it is possible to depict integrating factors, practically mandatory, in the implanting in large airports: the stakeholders that will be involved; the milestones - which the FAA points to in three broad groups and divides them after, in a systematic way. The milestones that Eurocontrol points out in 16 major brands, of which ten are Highly Recommended.

The process, now implemented in almost a hundred airports around the world, will require later interaction with smaller airports as well. This is because they are also feeders of the system. For the gears to function correctly, they must also have processes for control and transfer of information and data, in a systematic and integrated way to the big world air traffic system.
It is, therefore, a matter for discussion that the next steps to be taken in the global A-CDM processes are aimed at airports with lower aircraft and passenger movement capacity that are currently A-CDM.
It is a challenge for future research work from the global airline industry as to how this complex process could be simplified to apply it quickly and on a smaller scale as reducing the number of stakeholders and compacting the milestones now recommended in airports of lower movement and always considering CDM in a general way.

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